

Important Terminology:

1. **Fallacy:** any pattern of erroneous or bad reasoning
2. **Logical Vulnerability:** refers to those topics about which people have difficulty being open-minded and rational
3. **Argument:** a set of premise statements from which a conclusion follows.
4. **Premise:** a premise is a reason for accepting a conclusion.
5. **Conclusion:** the decision made about the issue under consideration.
6. **Deduction:** reasoning from certainty. Reasoning from known facts that are inclusive
7. **Induction:** reasoning from probability. Reasoning from diverse facts by making generalizations.
8. **Abduction:** reasoning by hypothesis or from possibility. Reasoning which applies general principles to particular cases. Often used diagnostically in problem solving.
9. **Truth value:** refers to the factuality of the statements of premises and conclusion.
10. **Universal statements:** true of ALL instances in a class or category
11. **Generalizations:** generally true but allow for some exceptions.
12. **Cogency:** the premises of an argument establish strong support for the truth of the conclusion
13. **Inductive strength.** Refers to the amount of support the premises in an argument offer for the truth of the conclusion.
14. **Validity:** refers to the structure of deductive arguments
15. **Soundness:** describes deductive argument with true premises and a valid form
16. **Logical Operators:** connecting words which create compound statements whose truth value depends on the combination of the truth values of the individual components. Common examples: *not, or, and, if—then*
17. **Conditional arguments:** deductive arguments in which at least one premise has an IF—Then structure
18. **Certainty:** the result of a valid structure of a deductive argument
19. **R-E-T:** refers to the relevancy of evidence, the sufficiency of evidence, and the accuracy of evidence
20. **Truth:** the result of an effort to understand reality accurately using appropriate reasoning strategies

Plausibility Analysis

Plausibility analysis involves the evaluation of the premises of the argument in order to determine if they are true or plausible. The final judgment about the argument involves combining the results of inference analysis with the evaluation of the premises.

A Deductive Argument with a valid form and true premises will be SOUND.

An Inductive or Abductive Argument with strong inference and true premises will be COGENT.

What is a sound argument?

A sound argument is a deductively valid argument with TRUE premises. If the premises of such an argument are also plausible, then the argument is cogent as well as sound.

What is a cogent argument?

An argument with a strong inference link [valid structure for deductive arguments and strong probability for inductive and abductive arguments] and premises that are both plausible (likely to

be true) and relevant. **Plausibility** and **Relevance** both refer to the question of whether or not the premises support the conclusion. This connection is referred to in logic theory as INFERENCE.

Is accepting a conclusion as true sufficient to make the argument cogent?

NO! Without a strong inferential connection between premises and conclusion, the argument is weak. Cogency has nothing to do with the truth value of the conclusion. Cogency is the product of the plausibility of the premises times the strength of the inferential link.

$$\begin{array}{ccc} & \text{COGENCY} & \\ \text{Plausibility} & \times & \text{Inference} \\ \text{[Subjective = Plausible to whom?]} & & \text{[Objective = Evidence bound]} \end{array}$$

STRONG:

**If today is Tuesday then tomorrow will be Wednesday. Today is Tuesday.
Therefore tomorrow will be Wednesday.**

weak: *Today is Tuesday.
Tomorrow will be Wednesday.
Therefore I am wearing clothes.*

Evaluating the Truth of an Argument's Premises

It is important to notice the difference between **plausibility** and **possibility** in this regard because plausibility is a key criteria for accepting a premise as true while possibility merely suggests that it is not impossible.

Possibility: No reason to believe that it is impossible [e.g. squaring a circle, a married bachelor] but does not rule out the unlikely [e.g. abduction by aliens]

Plausibility: Strong support for believing in a statement's truth because of :

- 1) Personal experience
- 2) Reliable source of information. Because we use sources of information which we have lack the means to confirm through our own experience, we need to understand how to evaluate the authorities who are the source of our information.

Argument Type: Abductive

ABDUCTIVE ARGUMENTS are arguments in which the conclusion offers a possible hypothesis or diagnosis for the situation/problem described by the premises and follow the pattern:

Phenomena P
C explains P [P is caused by C]

Please become aware of a important difference between *EXPLANATION* and *CAUSE*.

Explanations do not always imply a causal relationship. For example, if I want to explain a break in pattern [a prediction based on an inductive series proves to be incorrect] of observational data, then I am looking for an explanation for the change rather than trying to provide a causal explanation in the strict sense.

EXAMPLE: John did very poorly on his economics exam. Sally told me that he studied very hard the night before but, since he had missed several important lectures, his bad grade suggests that cramming isn't an effective way learn enough about economic theory to pass the exam.

Schematization:

P1 John missed several important lectures

P2 Even though he studied very hard the night before, John did very poorly on his economics exam

[Phenomena to be explained]

C His bad grade suggests that cramming isn't an effective way learn enough about economic theory to pass the exam. [*hypothesis for failure*]

Inference Analysis: Type: Abductive The word *suggests* is a clue that the conclusion is an hypothetical explanation. Inference Strength: moderate (.5 to .7) John is only one student and the conclusion sets up a general statement. The argument fails to make a good case for that generalization [An inductive Argument by Example would be more appropriate strategy for this conclusion]

Plausibility Analysis: Moderate cogency. Premises must be assumed as fact. With the addition of the information about the missed lectures which are another way to learn information, this is makes a reasonable hypothesis for John's failure but link is only moderately strong.

Note: In cases where there is some kind of observed correlation between phenomena A and phenomena B that is the focus of the explanation, then there are 4 possible causal relationships between A and B:

1. A caused B
2. B caused A
3. A and B have a common cause: C
4. The correlation is accidental (the choice of last resort since it is hard to test).

Inference Strength and Plausibility Analysis for Abductive Arguments

In abductive arguments, the process of determining the degree to which the conclusion explains the evidence or phenomenon is closely related to the approach used to test plausibility. The same set of criteria is used in both cases. Because they are a form of induction, abductive arguments can only yield a high degree of probability not certainty. The argument is tested when the **probable** truth of the hypothesis has been demonstrated.

For example: Your car won't start. The list of possible reasons ranges from 'out of gas,' 'dead battery,' to the more expensive 'engine overheated and froze.' Deciding which of these is most likely involves inference analysis and considers a range of other relevant factors such as "Was the engine light on the last time you drove it?" in order to arrive at a course of action. Testing the truth of what you believe to be wrong, becomes the process of plausibility analysis.

Exercise: Make a list of situations in which abduction is the appropriate logical strategy to use and describe how you go about using this form of argument as a critical thinking tool.

You test the plausibility of the premises in an abductive argument by using the following criteria:

- Amount of confirming evidence
[How much data are you working with?] Example: A statistical survey which is not based on a large enough sample may lead to the fallacy, *Jumping to Conclusions*
- Variety of confirming evidence
[What are your sources of data?] Example: If you do only one experiment, you may be missing data that would refute the hypothesis.
- Simplicity
[Have you kept your hypothesis as simple as possible? An argument which offers a hypothesis that goes beyond what is necessary to account for the phenomena being examined can be misleading.] Example: Miraculous healing as an explanation for spontaneous remission of cancer.
- Testability
[Can the hypothesis be tested? A hypothesis that can't be tested is worthless as a strategy for critical thinking.] Example: No scientific procedure can prove the existence or non-existence of God (or angels, or the Devil etc.)

Abductive Argument at work: Either/Or versus Both/And

The Danish physicist Niels Bohr was a contemporary of Einstein. Like all physicists and philosophers, Bohr set out to discover the ultimate nature of things by comparing two arguments about what reality is. One side believed that *reality is a wave*. The other side believed that *reality is a particle*. What Bohr discovered is that if you ask the 'wave question' you get the 'wave answer' – and, if you ask the 'particle question', you get the 'particle answer'.

In other words, to frame the question in *either/or terms* – either wave or particle – is the wrong question. If the answer depends upon the question we ask, then it would seem that the real answer is very elusive unless we learn how to ask the real question. The real answer is

both/and. But the physicist cannot set up an experiment, which asks a question phrased as *both/and*. The physicist must set up an experiment, which is limited to either/or.

Since in other disciplines than physics, this is the argument between “energy versus matter” or “spirit versus flesh” or “mind versus body” or “theology versus biology”, there is a lesson here. All who would philosophize, theologize, moralize or even politicize about what is the “right thing” to think or to believe or to act upon or to legislate need to be very careful about the conclusions they make.

To limit answers to “either/or” alternatives seems a potential mistake, which flies in the face of actual reality. If the answer is “both/and”, then we must recognize that there may be more than only two potential answers to any question. Life seems to be composed of multiple facets, thus life offers multiple answers to the questions we need to learn how to ask.

Practice Argument:

The following article reports a set of experiments showing that stress increases the level of cholesterol in the blood. Identify the two parts of the argument using the abductive argument pattern. Decide how plausible you find the argument to be and be ready to justify that judgment using the appropriate method.

For more than a decade scientists have known that the body can manufacture morphine-like natural opiates, known as endorphins. Often released in times of stress, these chemicals can temporarily dull one's sensitivity to pain. But George K. W. Yam and his colleagues at Purdue University at West Lafayette, Indiana, appear to have discovered another function—one that seems to chemically link stress and heart disease.

"In research involving mice and rats, they have found signs that some as-yet-unidentified endorphin plays an essential role in the buildup of cholesterol in the blood serum of individuals under stress . . . In one test, the researchers subjected rats over a five-day period to the stress of randomly scheduled restraint in small cages for two to four hours. Compared with unrestrained rats fed the same moderately high-cholesterol diet, the stressed animals developed a near doubling in blood -cholesterol levels. There was also at least a doubling of low-density lipoproteins (LDLs) in the blood of these animals and a drop by one-third in high-density lipoproteins (HDLs). Since LDLs are associated with bringing cholesterol into the blood and tissues, and HDLs with removing cholesterol, these are ominous changes, says Henry Bryant, formerly with the Purdue team. . . Rats that were identically stressed after receiving naltrexone—a drug that blocks the effect of endorphins on the brain—developed no cholesterol increase and no change in lipoprotein levels. This ability of naltrexone to prevent the cholesterol-related effects of stress points to the hidden activity of some endorphins, Bryant says. Further support for an endorphin role was provided in other studies, he says, when morphine drug implants—replacing restraint as a “stress” —yielded virtually identical serum changes in the animals. This externally serum changes, he says. Like the endorphin effects, morphine's role was blocked by naltrexone."

[Science News, August 30, 1986]

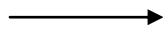
Argument Type: Inductive

INDUCTIVE ARGUMENTS are arguments in which the conclusion is predicted on the basis of the premises. **Arguments from Example** and **Arguments from Analogy** are both forms of Inductive reasoning. Arguments from Example are the most common and are the means by which we deal with observational data. Arguments from Analogy use the familiar to try to understand the unfamiliar by setting up a metaphorical relationship between two dissimilar things or experiences.

Arguments from Example follow the general pattern:

Sample has property P
General population has property P

#1 **Series a, b, c . . . has property P**
n . . . (next members of series)
will also have property P



Note: If this argument is based on a large consistent series that is the basis for the observed pattern this prediction is of the 'practically guaranteed' variety

#2 **Part (subgroup) has property P**
Whole (entire group) has property P



Note: This statistical pattern involves using a representative sample or piece of a whole to stand for the whole group. This dependence makes this kind of argument vulnerable to the fallacies of composition and division.

EXAMPLE: A recent college survey polled the study habits of students by calling random students whose phone numbers are listed in the college phone book. This study showed that 70% of the students who used cramming before a test as their most important study strategy failed to get grades higher than C- on their last exam. This study demonstrates that 7 out of 10 students who cram before an exam will fail to get a good grade. John needs to read this report and take notes!

Schematization:

P1 70% of the students who used cramming before a test as their most important study strategy failed to get grades higher than C- on their last exam

P2 John crams before his exams.

C John is risking 7-10 odds of getting a bad grade.

Inference Analysis: Argument by Example 70% of the students who used cramming before a test as their most important study strategy failed to get grades higher than C- on their last exam therefore 7-10 odds of getting bad grade if you cram.

Plausibility Analysis: Strength moderate [.7]

Practice Arguments by Example: Determine which of the two kinds of argument by example each of these arguments is by matching the pattern of the argument. Decide how you find the argument to be and be ready to justify that judgment using the appropriate method.

1) "In the total winter season from August 25, 1595, through February 28, 1596, . . . the company [the Lord Admiral's Men] gave one hundred and fifty performances of thirty different plays. Eighty-seven performances, or 58 per cent of the total were of the fourteen new plays produced that season. Five performances, 3.3 per cent, were of one play, *The Jew of Malta*, revived that season. Forty-six performances or 30.7 percent were given of the eight plays from the previous season were less than a year old. Only twelve performances, 8 percent, were of the seven plays which were more than a year old. This distribution, which is similar for all the seasons cover Henslowe's records, emphasizes how dependent the company was on the continuous addition of new plays to its stock in order to maintain itself in London." [Bernard Beckerman, Shakespeare at the Globe]

2) "U.S. business wastes \$2.6 billion annually on unnecessary money on photocopies, says a study for Accountemps, a New York -based temporary personnel service. Of the estimated 350 billion- photocopies made this year, one-third will end up in the trash."

[Wall Street Journal, August 28, 1986]

3) "The American Automobile Association reports that since the trucking industry was deregulated in 1980, price wars have forced some truckers to skimp on maintenance, making accidents more likely . . . "The statistics dramatize the AAA's concerns. In 1975 heavy trucks accounted for 3,483 highway fatalities in the United States. In 1984, the figure had risen to 4,908. "The trucking industry claims that trucks are involved in more accidents simply because there are more trucks driving more miles than ever before. But in fact, trucks account for more than their share of fatalities. According to a recent study of accidents on the New York State Thruway, for example, }heavy trucks were involved in an average of 2.8 fatalities for every 100 million miles traveled. The rate for passenger cars was less than half of that figure-1.3 per 100 million miles.'

[Editorial, Poughkeepsie Journal, February 21, 1986]

4) "In a study comparing the families of children who got into trouble at school by fighting, temper tantrums, stealing, vandalizing and the like with families of children who did not have such problems, Dr. [Gerald]Patterson's research found that the parents of disruptive children were three times more likely to display irritability to their children than were the parents is other children. He said he has found that when parents learn to use more constructive approaches, their children misbehave less." [New York Times, July 23, 1986]

5) "Modern men concerned about aging might track down a University of Oklahoma study. It discusses, in a sober and statistical way, the `life-enhancing properties of a younger wife." Researchers Laurel Klinger-Vartabedian, Dorothy Foster and Lauren Wispe discovered that younger wives appear to be a basis for a longer life span in men aged 50-79. The death rate for older men married to women one to 24 years younger was 13% lower than average for their age group. Men with older wives seemed to have a death rate 20% higher than average."

[Wall Street Journal, January 22, 1985]

6) "Support for the 55 mph speed limit is strongly influenced how fast people drive, according to a recent NBC News-Va. Street journal poll. People who say they drive no faster than 60 mph in good weather express overwhelming support for the speed limit. But most people who drive faster than 60--18 percent of those surveyed--oppose the law."

Poll results: Q. Do you favor or oppose keeping the 55 miles per hour speed limit?

	<u>Favor</u>	<u>Opposed</u>	<u>Undecided</u>
Those who drive 55 mph or slower	87%	11%	2%
Those who drive 56-60 mph	70%	29%	1%
Those who drive 61 mph or faster	34%	64%	2%

[Washington Post National Weekly Edition, June 9, 1986]

7) The United States has won all of the wars it has fought.

8) *Does Fiber Protect?* Nothing is written in stone-especially in medical science. Studies at the NH and the University of Arizona found no truth to the revered hypothesis that a high-fiber diet protects against colon cancer. Scientists tracked 3200 persons considered vulnerable because they'd had pre-cancerous polyps. Some followed high-fiber diets; some low-fiber diets; some stayed with their usual diets. Result: The amount of fiber did not affect the size or number of new polyps. Still, fiber probably does lower the risk of diverticulosis by reducing constipation, as well as the risk of diabetes and heart disease. *Dr. Rosenfeld's No. 1 best-seller, "Live Now, Age Later," is now in paperback.*

[PARADE MAGAZINE - May 28, 2000 - Page 11]

Arguments from Analogy are used to map the known [familiar] onto the unknown [unfamiliar]. Arguments from Analogy follow the pattern:

a and b have property P
a has property X
b has property X

Note that arguments from analogy -- unlike arguments from example -- do not require the same criteria of representative sample. Instead, the notion of **relevantly similar example** provides the critical standard for determining whether or not the argument is strong or weak. Counterexamples for analogies are called false analogies, which are a kind of fallacy.

EXAMPLE: Any student with good sense should be able to guess that cramming for an exam is not the most effective study strategy for getting a good grade. Why should a student expect to be able to master material well enough to do well on an exam just by studying overnight? After all, an athlete wouldn't expect to be able to get in shape the night before an important game.

Schematization:

a	b	P
P1	[Athletes] and [Students]	must both [prepare to succeed in their activities.]
a	X	
P2	[Athletes]	<u>[wouldn't expect to be able to get in shape the night before an important game].</u>
b	X	
C	[Students]	[shouldn't expect to be able to master material well enough to do well on an exam just by studying overnight].

Analogy: Mastering intellectual material like mastering a sport can't be achieved overnight.

Inference Strength: Strong because the analogy is **relevantly similar**.

Plausibility Analysis: Moderately strong because the analogy is strong.

Note: If the analogy does not meet the criteria of relevant similarity, then it commits the fallacy *False Analogy*.

Example: Q: Do you think the world is round or flat?
A: Both.
Q: Isn't that a contradiction?
A: No. After all, a pizza is both round and flat.

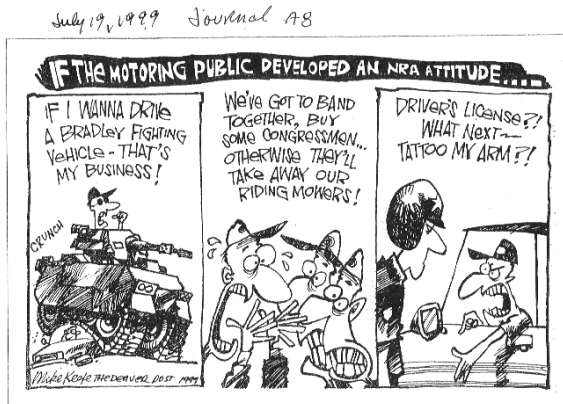
This argument commits two fallacies.

- The semantical **Fallacy of Equivocation** [word changes meaning within the argument] since the 'roundness' of pizza and the world is not the same kind of 'round'.
- The inferential **Fallacy of False Analogy** because the ambiguous meaning of *round*, destroys any possibility that the analogy compares relevantly similar properties.

Arguments by Analogy

Identify the 4-part pattern of the analogy [a,b, P and X] and the conclusion of the arguments by analogy listed below. Decide how plausible you find the argument to be and be ready to justify that judgment using the appropriate method.

- 1) The political cartoon below contains three arguments from analogy [Each panel is a different argument]. In order to identify the 4-part pattern, you must reconstruct the implied NRA arguments, which supply the other half of the analogy.



- 2) "Vigorous writing is concise. A sentence should contain no unnecessary words, a paragraph no unnecessary sentences, for the same reason that a drawing should have no unnecessary lines and a machine no unnecessary parts."

[William B. Strunk, Jr., and E. B. White, *The Elements of Style*]

- 3.) "The mode of taxation is, in fact, quite as important as the amount. As a small burden badly placed may distress a horse so a people may be impoverished and their power of producing destroyed by taxation, which, if levied another way, could be borne with ease."

[Henry George, *Progress and Poverty*]

- 4) Life's but a walking shadow, a poor player, That struts and frets his hour upon the stage, And then is heard no more. It is a tale Told by an idiot, full of sound and fury, Signifying nothing.

[William Shakespeare, *Macbeth*]

- 5) "What, after all, is the difference between shipping arms to Khomeini's Iran in 1986 and shipping arms to Hitler's Germany in 1939? Germany was of long-run strategic importance to America; the triumph of Ayatollah Khomeini's fundamentalism is likely to be as destructive to the Middle East as Hitler's Nazism would have been to Europe."

[Karen Elliott House, "This Iran Policy Makes Carter's Look Good,"
Wall Street Journal, November 13, 1986]

- 6) "If 'good' and 'better' are terms deriving their sole meaning from the ideology of each people, then of course ideologies themselves cannot be better or worse than one another. Unless the measuring rod is independent of the things measured, we can do no measuring."

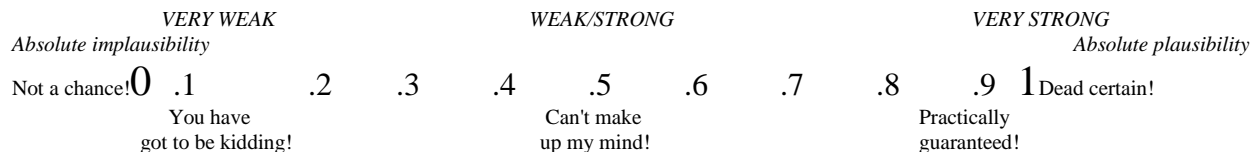
[C. S. Lewis, *Christian Reflections*]

PLAUSIBILITY ANALYSIS: Evaluating Inductive Arguments

A **cogent inductive argument** is one whose inferential link is (1) probabilistically strong [not conclusive] and (2) whose premises are plausible. Thus cogency is a matter of degree and the context of the argument usually determines the inferential strength required for cogency.

Inductive strength: an inductive or abductive argument's inductive strength is measured on a continuum from **Very Strong** support (almost certain) through **Strong** to **Moderate** to **Weak** to **No Support**.

THE FOLLOWING SCALE CAN BE USED FOR ESTIMATING PROBABILITIES:



Using this scale effectively to determine inference strength involves understanding the difference between 'certainty', 'possibility' and 'probability'. The scale reflects the full range of results. However, the difference between Deductive and Probabilistic arguments is reflected in a gap between the end points [*Dead Certain -- Not a Chance!*], which only apply to deductive arguments, and the range [*Practically guaranteed* to *You have got to be Kidding*] between those two points. The difference between 'probable'[high numbers] and 'possible'[low numbers] is determined by which end of the continuum you place the argument.

Another way to think about this scale involves understanding the relationships and differences between the following: *Vagueness, Ambiguity, Generalization, Universal and Analogy*

Universals are statements that are meant to be true in all cases of a certain class without exception; while **Generalizations** are meant to be true of the cases of a certain class with the admission of exceptions. Thus, when you think of these two categories - universals and generalizations - the focus is upon **Exceptions**.

When we think of clarity of meaning, we are dealing with vagueness and ambiguity. **Vagueness** is the case when there are not enough details for us to gain a meaning. **Ambiguity** is the case when we are uncertain which of two or more possible meanings are intended.

The word, *any*, will serve to illustrate these four definitions. Think of the definition of *any* in a quantitative sense. What does it tell you about amount? Nothing. In answer to the question "Are there any?" the answer may be: "None." Or it may be "Few" or "Some.". Neither of these last two answers is definite because each leaves us without clear meaning.

Think of *any* as the center word in a continuum of words running in two directions. Consider the following example. This example allows us to see the four concepts defined above in terms of quantity[Vagueness = any, Ambiguity = few or some, Generalization = least, less, more or most Universal = none or all]

	NONE	LEAST	LESS	FEW	ANY	SOME	MORE	MOST	ALL	
	←					→				
Quantity:	Universal	Generalization	Ambiguity	Vagueness	Ambiguity	Generalization	Universal			
Frequency:	Never	Sometimes	--ever	Rarely	--ever	Sometimes	Always			
Quality:	Empty	???		???		???	Full			

Notice how the scale created in this way matches the scale for determining inferential strength of arguments. The Universals at either end represent the two possible results for Deductive Certainty while the continuum from Generalization through Vagueness reflects the range of possible strengths available in Abductive or Inductive arguments where more than one conclusion is supported by the premises.

	VERY WEAK			WEAK/STRONG				VERY STRONG			
Absolute implausibility										Absolute plausibility	
Not a chance!	0	.1	.2	.3	.4	.5	.6	.7	.8	.9	1 Dead certain!
	You have got to be kidding!					Can't make up my mind!				Practically guaranteed!	

Now, think about the continuum in terms of frequency. The **Universals** found in deductive arguments would be *never* or *always*. The **Generalizations** found in Inductive or Abductive arguments would be *seldom* or *often*. *Rarely* is ambiguous. Does *rarely* mean “almost never” or “only once” or “a few times”? Vagueness would occur with *--ever*. for example: “Does it ever happen?”.

How would you employ this continuum in terms of quality? *Full* and *Empty* would be the extremes, the universals. Your assignment is to think of other words which will assist you in recognizing the presence of vagueness, ambiguity, generalization or universals. Look for antonyms and synonyms. Check your Thesaurus. Look for shades of meaning. Check your dictionary.

Two Methods For Evaluating Inductive Arguments

One quick way to determine the strength of an inductive argument's premises is the **R.E.T. Method**:

- R. Are the reasons **Relevant**?
 - E. **Enough** reasons? Sufficient information? Balanced for point of view?
 - T. **True**. Are the reasons demonstrably true?
- A fourth criteria is often helpful: **Check for counterexamples**

Three general criteria for evaluating whether or not the premises offer a representative sample: (1) multiple examples are preferable to one or two, (2) the examples must be representative and relevant, (3) background information about the sample is critical to determine its factuality. Notice that these criteria apply to statistical information.

The Alternative Conclusion Method for Inductive and Abductive Arguments

The Method Of Alternative Conclusions can be used to establish the strength of the inferential link. It uses the concept of **consistency** which holds that two or more sentences are consistent with each other if there exists a possibility that all the sentences are true [statements cannot contain contradictions without becoming ambiguous]; two or more sentences are inconsistent with each other if there is no such possibility [two or more statements contradict each other]. An **alternative conclusion** for a probabilistic argument is a conclusion that is consistent with all premises of the argument but inconsistent with its conclusion. In other words, the same set of true premises could lead to a different conclusion, which contradicts the original conclusion.

Basic Procedure for constructing a **counterexample** with an alternative conclusion:

1. Deny original argument's conclusion by supplying an alternative.
2. Repeat each of the premises in the original argument. [Consistency condition]
3. *Supply any necessary relevant* [Coherence condition] *premises* (i.e. add additional information) **Note: In some cases #3 may not be necessary and this is a clue that the argument is weak. The more information you have to add or the less plausible the new information has to be suggests that the original link is strong.**

Example: Sam's car was found by the side of the road this morning. The keys were in the ignition, and the car was in perfect working order. Sam's briefcase and jacket were still in the car. No one has seen Sam today. Furthermore, the Society for the Detection of Extraterrestrials reported that UFOs have repeatedly visited the area where Sam's car was found. Given this information, it is highly likely that Sam was abducted by extra-terrestrials.

Schematization:

P1 Car found without Sam but with Sam's possessions

P2 No one has seen Sam today.

P3 UFO Society reported that UFOs have repeatedly visited the area where Sam's car was found.

C Sam was abducted by extra-terrestrials

Inference Analysis: Abductive Argument [conclusion offers **hypothetical explanation** for Sam's disappearance].

Alternative Conclusion: Sam has amnesia and has wandered off forgetting his car. This conclusion is more plausible than original which suggests that the argument commits the *Far Fetched Hypothesis* Fallacy.

Inference Strength: Weak

Plausibility Analysis: Uncogent since the alternative conclusion is more probable as an explanation than the original conclusion.

ARGUMENT ANALYSIS CLASS EXERCISE

Schematization: (List premises and conclusion and Add implicit premises if necessary)

Inference Analysis: (What kind of argument is it? How much support do the premises offer the conclusion? Does it commit any fallacies?)

Plausibility Analysis: (Are the premises true? Is the argument sound or cogent? WHY?)

1. --Rooftop sightings in the Clinton section of Manhattan on a recent morning: one plastic great horned owl at 402 West 46th street, no pigeons; one plastic great horned owl at 503 West 47th street, no pigeons; two plastic great horned owls, at 461 West 47th street, no pigeons. "The owls work," claimed Sarah Weinberg, whose brownstone on West 46th Street bore no trace of pigeons. "A month ago, we could not stand outside the door because of all this gook falling from the sky." [New York Times 9/29/86]
2. "The wealth effect is a big reason consumer spending has remained healthy," according to Robert Giordano. He notes that in 1984 consumer spending rose 3.4 percent while incomes jumped a big 8 percent. Last year, consumer spending rose again by about 3 percent and incomes by 4.5 percent. "The point," explains Giordano "is that we had the same growth in consumer spending last year with half the growth in incomes. That means the rise in stock and bond prices is helping considerably to buoy consumption by increasing wealth and putting people in a spending mood." [US News and World Report 4/28/86]
3. In fact, speech seems to be rewarding to the infant in a way that other sounds are not. Newborns will learn to suck on an artificial nipple hooked to a switch that turns on a brief portion of recorded speech or vocal music, but they will not suck as readily in order to hear instrumental music or other rhythmical sound. [de Villiers, *Early Language*]
4. Decoration is not given to hide horrible things: but to decorate things already adorable. A mother does not give her child a blue bow because he is so ugly without it. A lover does not give a girl a necklace to hide her neck. [Chesterton *Orthodoxy*]
5. According to the National Safety Council, farming is the nation's most dangerous job. In 1983 farming clocked in at 55 job-related deaths per 100,000 workers, or five times the rate for all major industries combined. [The New Republic 12/8/86]
6. Dr. John Beary III, director of the Georgetown University Medical Group, argues that physical exams should be given to people under age 40 every other year and to those over 40 annually. "People take their care in for servicing every few month without complaint," he says. "Why shouldn't they take similar care of their bodies?" [US News and World Report, 8/11/86]

Argument Type: Deductive Arguments

The distinction between Deductive and Inductive/Abductive arguments:

Deductive arguments are arguments in which the inferential connection (link between premises and conclusion) is called **conclusive**. The inferential connection is conclusive if and only if there is no logical possibility in which all the premises are true and the conclusion false [If and only if conditional]. Deductive arguments are arguments that claim to be conclusive in the above sense.

The 'IFF' condition means that conclusiveness is not a matter of degree. As a result of this, the concept of logical possibility can be used to separate arguments into **deductively valid arguments** which have conclusive inferential connections (i.e. if their premises are true, then their conclusion necessarily follows) and **arguments** whose inferential connection fails to be conclusive. **A deductively sound argument is a deductively valid argument with TRUE premises. If the premises of such an argument are also plausible, then the argument is cogent as well as sound.**

VERY IMPORTANT Terminology:

- The words '**Valid**' and '**Invalid**' refer only to the pattern of arguments not to the truth or correctness of the statements in the argument. If an argument pattern is valid, then there is no possible case in which the premises of the argument are true and the conclusion is false.
- The words '**True**' and '**False**' refer only to the possible truth value of any statements or terms (e.g. premises or conclusion) within the argument.
- **Deductive Counterexample** is the method for determining if the pattern of an argument is valid.
- **Truth Tables** list all the possible combinations of truth values for any complex statement so that the truth value of that statement can be determined. They are used to check a deductive argument for validity by demonstrating that any possibility for a counterexample (the premises of the argument are true while the conclusion is false) has been eliminated.

Counterexamples: The test for conclusiveness is called a *counterexample*. A *counterexample* is a coherent and consistent story (i.e. logically possible story) in which the premises of the argument remain true but the conclusion is false. Counterexamples are used to distinguish **valid** from **invalid** deductive forms.

It works as follows: The deductive principle of Soundness means that a valid argument form with true premises guarantees the truth of the conclusion. If it can be shown that a logical possibility exists in which true premises yield a false conclusion, then the form is invalid

Schematizing Deductive Forms: The test for **validity** involves testing the pattern of the argument. The pattern of validity must be shown to cover all possible cases of the argument since only one case in which true premises lead to a false conclusion is necessary to demonstrate that the form is invalid. Since there are an unlimited number of possible arguments having that form, in order to evaluate the form, the content of the argument must be removed and replaced with

neutral letters. This translation begins by recognizing words like **IF, THEN, SOME, ALL, NONE, NOT** that appear in the forms themselves. These words are called ‘**logical operators**’ and they are used to construct complex statements such as **IF A THEN C** and tell you what logical operation is being performed on the content. The logical operators are like a software program that processes any data fed into it. After these operators have been identified, the content of the argument is taken by letters that function as place holders to represent the content.

Note: Attention to precision is helpful here. If you can translate the argument in this way, you have only shown that the argument could be deductive. The final step of determining that an argument is deductively valid involves showing that its pattern is valid by checking for counterexamples. **Invalid argument patterns are not necessarily weak arguments. The argument may be an inductive argument masquerading as a deductive argument in order to make a fallacious claim of certainty when the strongest legitimate inference can only be probable.**

Recognizing Deductive Forms:

- The following words, called **logical operators**, function as part of the logical structure of language. These words are characteristic of DEDUCTIVE arguments and so help identify them during Inference Analysis.

ALL
NONE
SOME
AND
OR
NOT
IF -- THEN

ONLY
NECESSARY
SUFFICIENT
NEVER
ALWAYS
IF AND ONLY IF

- Check to see if you can find alternative conclusions in which the premises are true but the conclusion would make the original conclusion false. Example:

P1 Mary placed \$10 on the table.

P2 Three reliable witnesses saw Tom pick up \$10 from the table.

Therefore, Tom has Mary's \$10. = C

Alternative Conclusion: All the above premises remain true. However, as soon as he picked up the \$10, Tom walked out of the room and gave it to Sally.

Alternative Conclusion: Sally has Mary's \$10. (Notice that the counterexample only has to give a logically possible account of the premises and conclusion as stated in the argument. This counterexample depends on the verb tense in the conclusion -- Interpretation again!)

This counterexample offers logically possible (i.e. the original premises remain true) conclusions that make the original argument's premises true but which, if true, would make the original conclusion (C) false. Any possible alternative conclusion will work no matter how far fetched. For example, it is possible (however unlikely) that aliens picked Tom's pocket and so he no longer has Mary's \$10. The point about deductive certainty is that, if the premises are true, there is only one possible conclusion. Thus this argument fails to pass the test for conclusiveness and so is an example of an inductive argument.

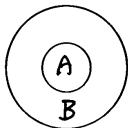
Deductive Argument Type: CATEGORICAL ARGUMENTS

In practice, the Method of Counterexample used depends on the kind of deductive argument under analysis. **Venn Diagrams** are used to evaluate the validity of **categorical syllogisms**, which are deductive arguments with two premises, which relate two (or more) categories of things. For example: *Socrates is a man and will die someday because all men are mortal.*

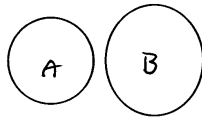
Venn Diagrams translate statements like *All A are B* into diagrams that picture the relationship stated in the Premises and so **only the premises are diagrammed**. Reading the Venn diagram (remember only the premises are used to draw the diagram) may offer a different conclusion from that found in the original argument. When this happens, you have a counterexample. If the argument's conclusion also appears in the diagram then the argument is valid because only one conclusion is possible.

Basic Patterns of Venn Diagrams:

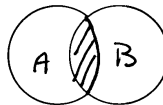
All A are B.



No A are B.



Some A are B.



x is a member of A



Example of argument analysis using Venn diagram to test for validity:

Argument:

Socrates is a man and will die someday because all men are mortal.

Schematization: P1. All men are Mortal.

P2 Socrates is a Man.

C Socrates will die.

Translation to form:

H= man, M= Mortal

x = Socrates (particular human)

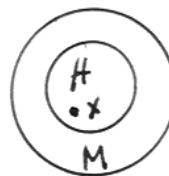
P1 All H are M.

P2 x is H.

C x is M

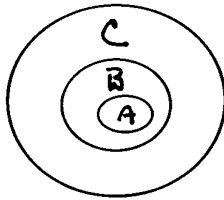
Demonstration of Validity using Venn Diagram:

This is a sound argument.



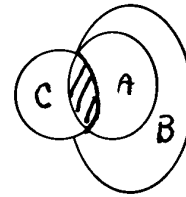
Examples of valid categorical syllogisms:

Universal Syllogism



All A are B
All B are C
 All A are C

Universal to Particular Syllogism

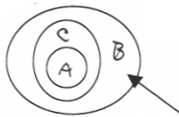


All A are B
Some A are C
 Some B are C

In both cases, the conclusion is represented in the diagram of the premises so the arguments are both valid.'

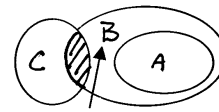
Invalid Categorical Arguments

Counterfits: These examples of fallacious reasoning reveal the importance of maintaining a consistent order. *All A are B* is not the same as *All B are A*.



All A are B
All A are C
 All B are C

Diagram conclusion: "Some B are not C"
 which makes the conclusion All B are C
 false
 since universal statements admit no
 exceptions.

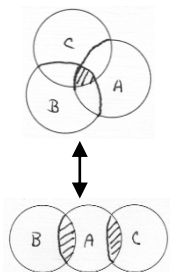


All A are B
Some B are C
 Some A are C

Diagram conclusion: "No A are C"
 which makes the conclusion "Some A are
 C" false since 'some' means 'at least one'
 and there is no overlap in the diagram
 between A and C.

Discovering Invalid categorical arguments like the one above is helpful because they demonstrate that there was not enough evidence to draw a conclusion and so indicate that more information is needed.

Some A are B
Some A are C
 ?



Both diagrams represent a possible pattern of relationship between A, B and C. Each diagram reaches a different conclusion. There is no way of determining which is the correct representation of the relationship. Therefore the form is invalid.

ARGUMENT ANALYSIS CLASS EXERCISE

Schematize and translate into deductive form

Evaluate Validity of Argument by using Venn Diagrams

1. All Cretans are liars and he is a Cretan, so you can't believe a word he says.

2. No nonprofit corporation sells stock, but some hospital corporations do sell stock, and therefore are for-profit organizations.

3. All great orchestra conductors are flamboyant, but none of them is careless. Thus some flamboyant people are not careless.

4. All squares are rectangles.

5. All food made from vegetables is good for you. Sugar is made from beets, which are vegetables, so sugar is good for you.

Deductive Argument: CONDITIONAL ARGUMENTS

Deductive Validity and Truth values

In conditional arguments, at least one premise follows the form ‘**If A then C.**’

The letters *A* (the antecedent) and *C* (the consequent) stand for facts whose truth can be determined. This is a complex statement in which the truth values of the components in the IF-Then relationship determine the truth value of the entire proposition. Determining truth values of complex statements like conditionals is important because in deductive argument, **SOUNDNESS**, which guarantees the truth of the conclusion, is determined by a use of a **deductively valid argument form plus true premises.**

Counterexample Method for Conditionals and other complex sentential deductive forms

In dealing with other deductive forms, the counterexample method uses on the effect of various logical operators on the truth value of complex statement to assess the number of possible combinations of true and false that make up the final truth value of the statement. These possible combinations are finite and their limits are set by the number of terms in the statement; the more terms and logical operators that are used, the more complex the argument. The number of possible combinations of terms grows exponentially each time one additional term is added to the argument. A one term argument has two potential values: true, false. A two term argument has four potentials; a Three term argument has eight potentials; a four term argument has sixteen potentials etc. Truth tables show all the possible combinations in a clear format.

One Term Table

<u>A</u>
T
F

Two Term Table

<u>A</u>	<u>B</u>
T	T
T	F
F	T
F	F

Three Term Table

<u>A</u>	<u>B</u>	<u>C</u>
T	T	T
T	T	F
T	F	T
T	F	F
F	T	T
F	F	T
F	T	F
F	F	F



A term or statement is either true or false.

Parmenides' Law of Non-Contradiction

Logical Operators and Truth Tables:

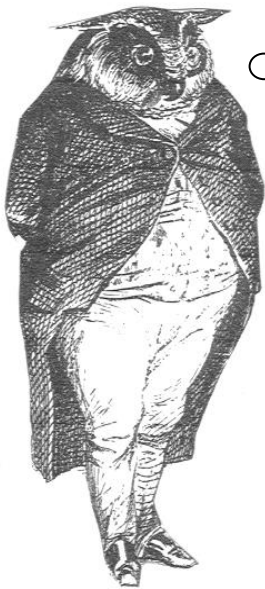
Logical operators function by *operating* on the truth values of the statements they connect. These statements are represented by letters of the alphabet which serve as neutral place holders. All statements that are part of a deductive argument are either true or false. This condition is called *bivalence*. Because the absence of a counterexample proves that a deductive argument's pattern is valid (i.e. will hold for all possible examples of that argument), all possible combinations of truth values covered by the logical operators in the argument must be examined in order to show that no counterexample can exist. These possible combinations of truth values are shown as Truth Tables. Each logical operator has its own truth table.

Logical operators for logical operators OR, AND:

A	B	A or B
T	T	F
T	F	T
F	T	T
F	F	F

A	B	A and B
T	T	T
T	F	F
F	T	F
F	F	F

The more complex the pattern, the more complicated the truth tables become because each logical operator affects the final truth value of the statement. See Truth Table for Material conditional for an example of a compound logical operator which combines the operators AND with IF-THEN.



Oh Dear!
There are at least 256
different valid
deductive argument
forms and only four
hours!
What to do!
What to do!

The Truth Value of Conditional Statements

Conditional statements reflect the connection between a condition and its outcomes. A **necessary condition** means that if the condition does not occur then the consequences also do not occur. A **sufficient condition** means that if the condition does occur then the consequence also occurs but it does not imply that the condition is the only possible reason for the consequence. It describes a looser connection between antecedent and consequent than the word ‘necessary’. Conditionals come in two strengths: Material Implication (IF – THEN) and Material Conditional (IF AND ONLY IF).

Material Implication: IF – THEN

The weaker conditional (If A then C) is called **material implication** because the antecedent (A) only implies the consequent, i.e. A is sufficient but not necessary for the consequent (C) to occur. Its possible truth values are listed in the table below.

A	C	If A then C
T	T	T
T	F	F
F	T	T
F	F	T

Note: It is the final column that gives the truth value of the compound sentence for the values listed in the first two columns.

Material Conditional: IF AND ONLY IF

The **material conditional** (A if and only if C) is a stronger conditional statement because it imposes more strict conditions for truth value than the material implication. A statement of material conditional implies that the antecedent (A) is a necessary and sufficient condition for the consequent (C) to occur. Another way to translate ‘A if and only if C’ is ‘**IF A THEN C AND IF C THEN A**’, which is a compound statement combining two logical operators – the **conditional** (If—Then) with the **conjunction** (And). Its possible truth values are listed in the table below.

A	C	If A then C	AND	If C then A
T	T	T	T	T
T	F	F	F	T
F	T	T	F	F
F	F	T	T	T

Note: It is the center column in bold type that gives the final truth value of the compound sentence. This value is found by taking the truth values of the two conditional sentences whose truth values are derived from applying the truth values of material implication to columns 1 and 2 and then applying the logical operation of Conjunction to those values in columns 3 and 5.

Two valid deductive arguments with a conditional premise: In both of these arguments, if both the premises are true, then the conclusion must also be true in **ALL POSSIBLE CASES** listed in the truth table. These two arguments are therefore valid deductive forms. **Remember: A counter example has true premises and a false conclusion.**

Affirming the Antecedent (Modus Ponens)

If A then C

A
C

Conditions for Counterexample:

If A then C = T
A = T
C = F

Any argument form that has even a single possible case with the above pattern is **INVALID** because **VALIDITY** depends on showing that no possible case exists where both premises are true and the conclusion is false.

	A	C	If A then C
→	T	T	T
→	T	F	F ← not counterexample
	F	T	T because premise must be true
	F	F	T

Steps for Counter example test:

1. Since you know that both premises must be true for a counter example, you know that **A = T** and **If A then C=T**. [arrows on Truth Table indicate the possible cases for counterexample.]
2. Since **A = T**, the only possible truth value for C is T because if C=F then If A then C= F. [Check Truth Table to confirm that all possible cases are covered]
3. Therefore there is no possible case in which the premises are true and the conclusion is false. **The argument is valid.**

Example: The instructor said that she hates driving in snow and so if it snows, class is canceled. It's snowing hard outside today. I won't bother to go to class.

Schematization:

A C
P1 If [it snows] then [class is canceled.]
A
P2 [It's snowing.]
C
C [Class is canceled.]

No alternative conclusion exists that makes P1 true and C false because if A is true C must also be true for the conditional to be true. The formal analysis demonstrates this for all possible examples of this argument. The argument is valid.

Denying the Consequent

(Modus Tollens)

If A then C

Not C

Not A

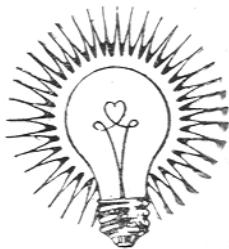
Conditions for Counterexample:

If A then C = T

Not C = T

Not A = F

Any argument form that has even a single possible case with the above pattern is INVALID because VALIDITY depends on showing that no possible case exists where both premises are true and the conclusion is false.



Example: If the light bulb in this lamp is burned out, the light won't come on. I just put in a new light bulb so the lamp should work.

Schematization:

A C
P1 If [bulb is burned out], then [light won't come on]

Not A

P1 [replaced old bulb with new bulb]

Not C

C [Light will come on]

There is no alternative conclusion to this, since if the light doesn't come on, then C is false when not A is true. If C is false, then the only case in which P1 *If A then C* remains true is when A is also false [bulb not replaced since 'NOT A' is the replaced bulb]. But since not A is true because

A	C	If A then C
T	T	T
T	F	F
→ F	T	T
→ F	F	T

← neither is counterexample

← because conclusion always true

Steps for Counter example test:

1. Since you know that both premises must be true for a counter example, you know that **Not C = T** and **If A then C=T**.
2. Since Not C =T, the only possible truth value for C is F because the logical operator NOT switched the truth value to its opposite. [arrows on Truth Table indicate the possible cases for counterexample.]
3. If C=F then A=F because, if A=T when C=F then If A then C= F. [Check truth table]
4. If A=F, then Not A=T[Check Truth Table to confirm that all possible cases are covered]
5. Therefore there is no possible case in which the premises are true and the conclusion is false. **The argument is valid.**

you just put in a new bulb that cannot be the truth value of P1. However, as a result of this failure, you now know that a new light bulb will not solve your problem.

INVALID ARGUMENT FORMS than counterfeit the valid forms

Denying the Antecedent

If A then C

Not A

Not C

A	C	If A then C
T	T	T
→ T	F	F
→ F	T	T ← counterexample
F	F	T

Conditions for Counterexample:

If A then C = T

Not A = T

Not C = F

Any argument form that has even a single possible case with the above pattern is INVALID because VALIDITY depends on showing that no possible case exists where both premises are true and the conclusion is false.



Steps for Counter example test:

1. Since you know that both premises must be true for a counter example, you know that **Not A = T** and **If A then C=T**.
2. Since Not A =T, the only possible truth value for A is F because the logical operator NOT switched the truth value to its opposite. [arrows on Truth Table indicate the possible cases for counterexample.]
3. Since A=F, C can be either F or T because If A then C= T for either value of C. [Check Truth Table to confirm that all possible cases are covered]
4. Therefore there is ONE possible case in which the premises are true and the conclusion is false. **The argument is invalid because a counter example exists.**

Example: If the light comes on, the switch must be working. This light isn't on, so the switch in this lamp must be broken.

Schematization:

A C
P1 If [light on], then [light switch works]
Not A
P1 [light off] _____
Not C
C [light switch broken]

Affirming the Consequent

$$\frac{\mathbf{C}}{\mathbf{A}}$$
$$\frac{C=T}{A=F}$$

	<u>A</u>	<u>C</u>	<u>If A then C</u>	
→	T	T	T	
	T	F	F	
	F	T	T	← counterexample
→	F	F	T	

Notice that an alternative conclusion exists so this is an invalid deductive argument which counterfeits the valid deductive form, *Affirming the Antecedent*. This kind of argument is called the fallacy of *Affirming the Consequent*. The building has burned down and that is why class has been canceled. The instructor is feeling fine.

ARGUMENT ANALYSIS CLASS EXERCISE

Schematize and translate into deductive form

Evaluate Validity of Argument by using the counterexample method

1. Since optimists are more likely to succeed than pessimists, it is preferable to be an optimist.
2. If there are millions of habitable planets in our galaxy, then it seems probable that life has evolved on more than just this one.
3. Sherlock Holmes solved a case which took place in a stable by observing that a dog was kept in the stalls, and yet, although someone had come in and taken a horse, the dog had not barked. Obviously the visitor was someone whom the dog knew well.
4. Hydrogen is steadily converted into helium throughout the universe, and this conversion is a one-way process. If the universe were infinitely old, there would be no hydrogen left in it. But in fact the universe consists almost entirely of hydrogen. The universe must have had a definite beginning.
5. If the instructor gets sick, class will be canceled. I know the instructor has a bad cold so I'm not going to class.
6. Cars will not start if their batteries are dead. My car won't start.